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MIAMI NATURAL RADIOCARBON MEASUREMENTS II*

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INTRODUCTION

The C^{14} dates given below are a continuation of the work presented in our first list (Miami I) using the same apparatus and techniques described previously. In addition to the dating of marine carbonate materials, however, we have extended our methods to the dating of wood and peat samples. All dated peat and wood samples have been given a standard pretreatment by successive washings with dilute HCl and 2% NaOH solution for removal of carbonates and humic acids (Olson and Broecker, 1958). Where sufficient alkali-soluble "humic acid" was recoverable for analysis, this fraction was dated separately and is included with the date obtained from either the wood or peat.

The reported ages were obtained by using a 1.0-L CO_2 proportional counter operating at 3 atm pressure. Samples were measured at least twice for a 1000-minute counting period each and a minimum of 14 days between counting periods. In cases where dilution was necessary because of small sample size, those samples were counted three times. Ages are δC^{13} corrected and have been calculated in the usual way by comparison with the 95% activity of the NBS standard, using a half life of 5568 $\pm$ 30 yr, referred to A.D. 1950. From the calculated age of marine carbonate material we have subtracted 400 yr as an apparent sea-surface carbonate age (Miami I). No such correction is made for organic material. The uncertainty in the given ages includes the experimental standard deviation in the count rate of the modern standard, the unknown and the background, and the standard deviation of the half life of C^{14}.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES FROM DEEP-SEA CORES

Tongue of the Ocean, Bahamas, B. W. I.

Dating of core samples from the Tongue of the Ocean represents a continuation of the program outlined in our previous list (Miami I). Two new cores (MG 61-8, and MO 62-29) have been added here to the former list. The

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ages reported for the other cores in this group extend the series of dates on cores described previously. These data provide information related to (1) rates of sediment accumulation, (2) periodicity of turbidite deposition, (3) estimates of carbonate supply rate from the Bahama Banks to the Tongue of the Ocean basin, and (4) insight into the anomalous behavior of Ra^{226} distribution in the sediments. Unless stated otherwise, all samples in this series were collected by Marine Laboratory staff and were submitted by G. A. Rusnak.

It had been demonstrated earlier (Miami I) that dates of turbidite layers in the cores are unreliable as indicators of emplacement age for that layer. The coarse-grained carbonate deposited out of a turbidity current can be nearly twice as old as the immediately underlying fine-grained pelagic carbonate. Turbidite layers represent materials which have been reworked from older deposits formed on the unstable slopes of this steep-sided basin. It is clear from the MG 60-18 series that the fine fraction of the turbidite layers also is reworked material which must have been entrained in the turbidity current. Age of turbidite layer and time of its emplacement thus can be evaluated only by dating the pelagic carbonate layer underlying the turbidite. An average δC^{13} value of +3.25‰ (based on 18 calcilutite samples) was used for all Tongue of the Ocean samples where no value is stated separately.

Core MG 57-18 series

Gravity core collected from the center of the Cul de Sac (23° 40′ N Lat, 76° 52′ W Long, water depth 1253 m). This core had been supposed to be largely uninfluenced by turbidity-current deposition as indicated by its lithologic uniformity. Analyses for Ra^{226} by B. Szabo, however, showed some variation which raised suspicions about the uniformity of the core. The single date (ML-13) of this core from our previous list is included here to complete the series. Core is composed entirely of calcilutite.

ML-52. MG 57-18, 0-3 cm — **300 ± 70**, **A.D. 1650**

Bulk $CaCO_3$.

ML-53. MG 57-18, 10-15 cm — **2105 ± 65**, **155 B.C.**

Bulk $CaCO_3$; $\delta C^{13} = +3.61$.

ML-54. MG 57-18, 30-35 cm — **2515 ± 65**, **565 B.C.**

Bulk $CaCO_3$; $\delta C^{13} = +3.27$.

ML-13. MG 57-18, 44.5-49 cm — **4000 ± 100**, **2050 B.C.**

Bulk $CaCO_3$.

General Comment (G.A.R.): this series demonstrates that although the core lithology appears uniform, the assumption of uniform deposition rate cannot be made for this area even for short time intervals. The core section between the dated units at 30-35 cm and 10-15 cm shows an accumulation rate approximately six to seven times higher than either of the sections above or below. As this section does not exhibit obvious disturbances or turbidite features, the high rate may be accounted for by sudden slumping of contemporaneous calcilutite, from some higher level in the basin.

Core MG 57-11 series

Gravity core collected from N end of basin axis (24° 59′ N Lat, 77° 44′ W Long, water depth 2489 m). Core appeared to be a fairly homogeneous calcilutite except for an ill-defined turbidite zone at depth ca. 12-21 cm. An earlier (Miami I) date from near the bottom of this core (ML-12) was supposed to provide an estimate of the accumulation rate unaffected by the complication of turbidity-current deposition. The date is included in this completed series.

ML-55. MG 57-11, 0-3 cm **845 ± 60**
A.D. 1105

Bulk $CaCO_3$; $\delta C^{13} = +2.78$.

ML-56. MG 57-11, 14-21 cm **2370 ± 65**
420 B.C.

Bulk $CaCO_3$; $\delta C^{13} = +2.91$.

ML-57. MG 57-11, 21-25 cm **2315 ± 65**
365 B.C.

Just below ill-defined turbidite. Bulk $CaCO_3$; $\delta C^{13} = +4.53$.

ML-58. MG 57-11, 30-35 cm **2500 ± 65**
550 B.C.

Bulk $CaCO_3$; $\delta C^{13} = +2.67$.

ML-12. MG 57-11, 60-65 cm **3700 ± 90**
1750 B.C.

Bulk $CaCO_3$.

General Comment (G.A.R.): like the previous core, this series shows an exceptionally high accumulation rate for a time ca. 2500 yr ago when compared to other sections of the core. The ill-defined turbidite layer ML-55 shows an older age than its underlying unit ML-56 and thus demonstrates its reworked nature.

Core MG 58-6 series

Gravity core collected from axial center of basin (23° 58′ N Lat, 77° 18′ W Long, water depth 1369 m). A single date from this core was recorded in the earlier list, but additional dates were made to obtain more information concerning the Ra^{226} distribution analysed by B. Szabo. The earlier date (ML-14) is included to complete this series.

ML-60. MG 58-6, 0-4 cm **1515 ± 60**
A.D. 435

Bulk $CaCO_3$; $\delta C^{13} = +2.56$.

ML-61. MG 58-6, 9-13 cm **1810 ± 65**
A.D. 140

Bulk $CaCO_3$; $\delta C^{13} = +2.63$.

ML-62. MG 58-6, 19-23 cm **3650 ± 70**
1700 B.C.

Just below ill-defined turbidite. Bulk $CaCO_3$; $\delta C^{13} = +3.08$.

ML-63. MG 58-6, 35-40 cm **4335 ± 75**
2385 B.C.

Bulk $CaCO_3$; $\delta C^{13} = +2.67$.

ML-14. MG 58-6, 55-60.5 cm **6615 ± 130**
4465 B.C.

Bulk $CaCO_3$.

General comment (G.A.R.): top 4 cm contains an ill-defined turbidite layer with reworked sediment and therefore date is too old.

Core MG 60-18 series

Gravity core collected from E side of basin (24° 10′ N Lat, 77° 17′ W Long, water depth 1380 m). This core exhibits extensive layers of turbidite sands and had been dated earlier to determine frequency of turbidity flows. The following ages have been determined on the coarse ($>62\mu$) and fine ($<62\mu$) fractions of single turbidite units to further test the hypothesis that the coarse fraction is older than the fine. Test results were as expected.

ML-66. MG 60-18, 0-1.5 cm **1210 ± 140**
A.D. 740

Coarse fraction $CaCO_3$; $>62\ \mu$.

ML-67. MG 60-18, 0-1.5 cm **1180 ± 90**
A.D. 770

Fine fraction $CaCO_3$; $<62\ \mu$.

ML-68. MG 60-18, 86-89 cm **7700 ± 115**
5750 B.C.

Coarse fraction $CaCO_3$ $>62\ \mu$.

ML-69. MG 60-18, 86-89 cm **6950 ± 105**
5000 B.C.

Fine fraction $CaCO_3$ $<62\ \mu$; $\delta C^{13} = +3.29$.

General comment: neither the coarse nor fine fraction may be expected to give reliable ages for stratigraphic horizons containing turbidity current deposits.

ML-75. Core MG 60-14, 13-18 cm **7890 ± 100**
5940 B.C.

Piston core taken along axis of basin due E of the S tip of Andros Island (23° 49′ N Lat, 77° 14′ W Long, water depth 1345 m). Nearly undisturbed except for turbidite layer in upper 10 cm. Our earlier list (Miami I) gave dates from section 0-5 cm (ML-17), 75-80 cm (ML-19), and 145-150.3 cm (ML-20). The 8275 ± 120 (ML-17) age for the 0-5 cm section was too old because it contained reworked materials. The 13-18 cm section dated here indicated pelagic sedimentation, uncomplicated by reworking, and therefore is considered reliable.

ML-80. Core MO 62-29, 129-134 cm **4425 ± 70**
2475 B.C.

Gravity core collected from the Cul de Sac (23° 33′ N Lat, 76° 57′ W Long, water depth 1300 m). Core contains turbidite sand layers at 37-45 cm and 74-77 cm, but dated section appears undisturbed and should make possible a reliable estimate of bulk accumulation rate. Coll. by F. Busby. Bulk $CaCO_3$; $\delta C^{13} = +2.70$.

ML-81. Core MG 61-8, 138-143 cm **6160 ± 80**
4210 B.C.

Gravity core collected from SW side of the Cul de Sac (23° 32′ N Lat, 77° 08′ W Long, water depth 1180 m). Core contains sand layers at 65-66 cm, 71-74 cm, 89-99 cm, and 106-108 cm. Dated section appears undisturbed and should give basis for a reliable estimate of bulk accumulation rate. Bulk $CaCO_3$; $\delta C^{13} = +3.75$.

Caribbean Sea

The two Caribbean core series included here have had extensive O^{18}/O^{16} analyses from which detailed paleotemperature curves have been constructed. In addition, sections of significant climatic changes have been dated by Pa^{231}/Th^{230} method (Rosholt et al, 1961, 1962). Hence, dating of various core sections was important to (1) establish a check on the Pa^{231}/Th^{230} method, (2) provide a closely-spaced series for dating early inflections in the paleotemperature curve, and (3) give sufficient dating detail for discrimination among changing accumulation rates related to the climatic events. In addition, a number of core sections have C^{14} dates determined from the separate coarse ($>62\mu$) and fine ($<62\mu$) fractions to evaluate possible contamination by reworked materials. This factor was of great importance in checking the Pa^{231}/Th^{230} dating because the method depends on the clay component for dating.

Core A 240-Ml series

Piston core collected from the central Caribbean (15° 26′ N Lat, 68° 30′ W Long, water depth 4180 m). Undisturbed *Globigerina*-ooze core with a well-defined stratigraphic sequence in the oxygen-isotope curve. Core sections for dating were selected on basis of temperature curve inflections and duplicate sections of zones used for Pa^{231}/Th^{230} dating. Dates arranged in order of increasing age and depth. Coll. by J. Zeigler and W. Athearn, Woods Hole Oceanographic Inst.; subm. by G. A. Rusnak.

ML-112. A240-ML, 0-6 cm **4140 ± 80**
2190 B.C.

Coarse $CaCO_3$ fraction 62μ. $\delta C^{13} = +1.53$.

ML-113. A240-ML, 0-6 cm **3555 ± 100**
1605 B.C.

Fine $CaCO_3$ fraction $<62\mu$. Avg. δC^{13} value of +1.51 used.

ML-70. A240-ML, 11-15 cm **8570 ± 150**
6620 B.C.

Coarse $CaCO_3$ fraction $>62\mu$. Avg. δC^{13} value of +1.51 used.

ML-71. A240-ML, 11-15 cm **8350 ± 120**
6400 B.C.

Fine $CaCO_3$ fraction $<62\mu$. δC^{13} value of +1.51 used.

ML-106. A240-ML, 36-43 cm **15,910 ± 215**
13,960 B.C.

Coarse $CaCO_3$ fraction $>62\mu$. $\delta C^{13} = +1.71$.

ML-107. A240-ML, 36-43 cm **14,310 ± 150**
12,360 B.C.

Fine $CaCO_3$ fraction $<62\mu$. $\delta C^{13} = +1.10$.

ML-108. A240-ML, 44-50 cm **17,600 ± 280**
15,650 B.C.

Coarse $CaCO_3$ fraction $>62\mu$. $\delta C^{13} = +1.50$.

ML-109. A240-ML, 44-50 cm **15,880 ± 190**
13,930 B.C.

Fine $CaCO_3$ fraction $<62\mu$. $\delta C^{13} = +1.76$.

ML-110. A240-ML, 57-63 cm **22,260 ± 450**
20,310 B.C.

Coarse $CaCO_3$ fraction $>62\mu$. $\delta C^{13} = +1.47$.

ML-111. A240-ML, 57-63 cm **19,340 ± 275**
17,390 B.C.

Fine $CaCO_3$ fraction $<62\mu$. Avg. δC^{13} value of +1.51 used.

General Comment (G.A.R.): the sedimentation model we have assumed for pelagic deposits requires that pelagic Foraminifera may often undergo co-deposition with older, bottom-transported fines. Thus C^{14} analyses of bulk carbonate or Pa^{231}/Th^{230} analyses of the fine clay could give ages older than the age of the Foraminiferal component upon which the stratigraphic record is based. The significantly older age of the coarse fraction in each section of this core indicates a reversal of the model we have selected for co-deposition of older and younger materials. Additional work is being done to arrive at a satisfactory model. The C^{14} date of the 11-15 cm section agrees with the Pa^{231}/Th^{230} date of 11,000 ± 3,000 yr B.P. (Rosholt et al., 1961, p. 176) obtained from the 11-20 cm section of this core. Excellent agreement between the two methods is especially evident in the fact that sedimentation rates between the top of the core and the two dated sections compared are virtually identical when the fine carbonate date is used. Thus the fine-carbonate fraction has here a similar sedimentation behavior to the non-carbonate clay fraction with which the Pa^{231} and the Th^{230} are associated. We might therefore assume, with reasonable assurance, that the Pa^{231}/Th^{230} age determinations on this core are reliable at all points dated.

Core A 254-BR-C series

Piston core collected from the Beata Ridge area of the Caribbean (15° 57′ N Lat, 72° 53.5′ W Long, water depth 2968 m). Another *Globigerina* ooze core exhibiting a well-defined stratigraphic sequence. Sections to be dated were selected on the basis of stratigraphic information and as a check on the Pa^{231}/Th^{230} dating of this core. Dates are arranged in order of increasing age and depth. Unless stated otherwise, we have used an avg. δC^{13} value of +1.51. Coll. by J. Zeigler and W. Athearn; subm. by G. A. Rusnak.

ML-94. A 254-BR-C, 0-4 cm **8860 ± 130**
7910 B.C.

Bulk $CaCO_3$; $\delta C^{13} = -0.93$. *Comment* (G.A.R.): top of core appears to have been lost during the coring operation.

ML-72. A 254-BR-C, 20-28 cm **12,480 ± 200**
10,530 B.C.

Coarse $CaCO_3$ fraction $>62\mu$.

ML-73. A 254-BR-C, 20-28 cm **12,770 ± 150**
10,820 B.C.

Fine $CaCO_3$ fraction $<62\mu$; $\delta C^{13} = +0.28$.

ML-95. A 254-BR-C, 38-42 cm **15,220 ± 220**
13,270 B.C.

Bulk $CaCO_3$. $\delta C^{13} = -1.55$.

ML-100. A 254-BR-C, 54-60 cm **18,785 ± 510**
16,835 B.C.

Coarse $CaCO_3$ fraction $>62\mu$.

ML-101. A 254-BR-C, 54-60 cm **19,100 ± 300**
17,150 B.C.

Fine $CaCO_3$ fraction $<62\mu$.

ML-96. A 254-BR-C, 68-72 cm **21,910 ± 430**
19,960 B.C.

Bulk $CaCO_3$. $\delta C^{13} = -1.91$.

ML-102. A 254-BR-C, 74-80 cm **24,350 ± 510**
22,400 B.C.

Coarse $CaCO_3$ fraction $>62\mu$.

ML-103. A 254-BR-C, 74-80 cm **22,870 ± 350**
20,920 B.C.

Fine $CaCO_3$ fraction $<62\mu$.

ML-97. A 254-BR-C, 98-102 cm **27,440 ± 950**
25,490 B.C.

Bulk $CaCO_3$. $\delta C^{13} = -3.00$.

General Comment (G.A.R.): the discussion of the Core A 240-ML series applies to this series except that the upper few cm of this core must have been lost during piston coring. There is no disagreement in the ages obtained by the two dating methods for comparable horizons of this core, although the Pa^{231}/Th^{230} date of 19,000 ± 4000 at 31-40 cm (Rosholt *et al.*, 1962) appears to be ca. 4000 yr older than the C^{14} date of 15,245 ± 220 (ML-95) at the 38-42 cm level. As there appears to be a small difference of C^{14} dates between the coarse and fine-carbonate fraction, it may be assumed that the Pa^{231}/Th^{230} age dates the core section within the experimental uncertainty of the method.

II. GEOLOGIC SAMPLES FROM COASTAL DEPOSITS

Florida

ML-87. East Naples, buried peat **3075 ± 65**
1125 B.C.

Black crumbly peaty sand (sample EN-1) bed 12 ft below surface in dredge pit (26° 12′ 40″ N Lat, 81° 47′ 46″ W Long), behind coastal dune tract at East Naples, Florida. *Comment* (G.A.R.): the peaty sand lies ca. 3 ft above sealevel (mean low water) and is thickly covered by rather clean sand. Age of peat agrees with similar beds from E central Florida as reported by Parker *et al.* (1955, p. 109) and indicates a common sealevel control of peat accumulation. More importantly, the date records the invasion of the peat by coastal sands in this area. Peat accumulation and cover of coastal dune sand indicates sealevel rose to present level by this time. Coll. 1962 by A. L. Glass, Univ. of Miami. Bulk organic; $\delta C^{13} = -18.41$.

Virginia

Thimble Shoals Channel series, Chesapeake Bay Highway Crossing

Engineer's borings taken in connection with the Chesapeake Bay Highway Crossing near Thimble Shoals, Virginia (36° 59′ N Lat, 76° 06′ W Long). Peat and wood samples from a buried peat body trending SSW-NNE at 80-98 ft below mean low water, underlain by subaerial erosion surface and overlain by marine sand and silt. Coll. 1962 and subm. by W. Harrison, Virginia Inst. Marine Sci., Gloucester Point, Virginia. Samples date flooding of the area by rising sealevel.

ML-89. Boring B-3, 85 ft below sealevel **11,180 ± 150**
9230 B.C.

Brown to black peat (sample SM 5 DB & 6D) containing fine sand and wood. Bulk organic; $\delta C^{13} = -23.81$.

ML-90. Boring M-28, 82 ft below sealevel **9930 ± 130**
7980 B.C.

Black to brown peat (sample SM 11-D). Bulk organic; $\delta C^{13} = -22.84$.

ML-91. Boring M-28, 89 ft below sealevel **14,870 ± 200**
12,920 B.C.

Black to brown peat (sample SM 13-D). Bulk organic; $\delta C^{13} = -24.30$.

ML-92. Boring SD-1, 87 ft below sealevel **<200**

Wood log (sample SM SD-1) fragment suggestive of old bog; $\delta C^{13} = -23.45$. *Comment* (G.A.R.): log sample (ML-92) is obviously a contaminant caused by boring operation and not representative of buried horizon. Significance of other dates in this series is discussed by Harrison and Rusnak (1962).

Hog Island Beach series

Wood, peat and marine shell samples from wave-cut exposure near S end of Hog Island, Virginia (37° 24′ 18″ N Lat, 75° 41′ 48″ W Long). Material of sample HIX consists of crumbly black to brown peat occurring as a layer 0.6 to 1.0 ft thick, 2 ft above high tide level. Peat layer is underlain by shell bed 0.5 ft thick (sample HIY) which overlies sand. A single thick-shelled *Mercenaria compechiensis* from HIY was used for dating after ca. 10% of outer surface was removed by HCl digestion. Sample HIZ consists of large fragment of *Pinus* stump whose base lies within or below the sand bed beneath layers HIX and HIY. Coll. 1962 and subm. by W. Harrison. Dates arranged from uppermost layer down.

ML-121. Layer HIX **760 ± 80**
A.D. 1190

Humic-acid-free organic fraction; $\delta C^{13} = -16.50$. *Comment*: alkali-soluble humic-acid fraction gave an age of 590 ± 80 yr, $\delta C^{13} = +2.11$.

ML-117. Layer HIY **1495 ± 75**
A.D. 455

M. campechiensis $CaCO_3$; $\delta C^{13} = +2.28$.

ML-118. Layer HIZ **<200**

Pinus wood; δC^{13} = –22.45. *Comment* (G.A.R.): stump is stratigraphically much younger than enclosing sediment and probably represents slump-covered drift wood. Other dates suggest post depositional uplift (Harrison and Rusnak, 1962).

ML-119. Paramore Island, sample PIA **<200**

Wood fragments in peat layer from low-tide, wave-cut nip at contact between organic silt and overlying coarse sand on N shore of Paramore Island, Virginia (37° 34′ 42″ N Lat, 75° 34′ 18″ W Long). Humic acid free *Juniperus* fragment; δC^{13} = –23.50. Coll. 1962 by M. Castagna and W. Harrison; subm. by W. Harrison. *Comment* (W.H.): this peat is at the same altitude as fresh water peat with tree stumps S of Virginia Beach, Virginia. Young age of this sample undoubtedly represents cut and fill action near inlet between barrier islands. Yale has dated a sample Y-924, of white pine from the Virginia Beach peat at 725 ± 70. (Yale VIII).

Wachapreague, sample WAB

Surface of a peat layer collected from 8 ft below mean low water at Wachapreague dock of Virginia Institute of Marine Science, Wachapreague, Virginia (37° 36′ 42″ N Lat, 75° 41′ 18″ W Long). Peat is overlain by 8 ft of organic silt, containing abundant grass stems grading up into sand and silt. Coll. 1962 and subm. by W. Harrison. *Comment* (W.H.): top of the peat marks a widespread change in rate of sedimentation in the marshes. Pollen analysis is in progress on this and related sections.

ML-120. Residual, after humic acid removal **<200**

δC^{13} = –17.55.

ML-120. Humic acid **<200**

δC^{13} = –16.01. *Comment* (G.A.R.): young age indicates that material from this site unreliable and very likely represents fill or contaminant from dock construction.

Georgia

ML-114. Pumpkin Hammock, sample VJ-1 **480 ± 60**
A.D. 1470

Shell sample from exposure along Duplin River at Pumpkin Hammock, Georgia (31° 27′ 05″ N Lat, 81° 17′ 14″ W Long). Shell consists entirely of *Crassostrea* and occurs 3 to 7 ft above mean low water at contact of Silver Bluff marsh and overlying Recent marsh. May date Silver Bluff marsh or Recent marsh formation. Coll. and subm. by J. H. Hoyt, Univ. Georgia, Marine Inst., Sapelo Island, Georgia. *Comment*: sample leached with 6 N HCl to remove incrusting material.

ML-115. Sapelo Island, sample 13-27:30 **1065 ± 65**
A.D. 885

Core sample from beach backshore at S end of Sapelo Island, Georgia (31° 22′ 58″ N Lat, 81° 16′ 17″ W Long). Shell material recovered from 17 to 20 ft below mean low water, may provide rate of prograding beach advance. Sample is mainly *Mulinia sp.* with some *Anadara* and *Crassostrea* and fragments; *id.* by R. Work, Univ. Miami. Coll. 1961 and subm. by J. H. Hoyt. *Comment*: ca. 30-50% of sample is discolored and suggests possible contamination which may not have been removed by acid leach of outer surface. δC^{13} = –1.49.

ML-116. Sapelo Island, sample 4-28 **8195 ± 110**
6245 B.C.

Core sample from beach backshore on Sapelo Island, Georgia (31° 23′ 27″ N Lat, 81° 15′ 54″ W Long). Shell consisting mainly of *Mulinia sp.* with a few fragments of *Anadara, Mercenaria, Crassostrea,* and *Trachycardium* (*id.* by R. Work) recovered from 18 ft below mean low water. Coll. 1961 and subm. by J. H. Hoyt. *Comment*: ca. 20% of sample is discolored and suggests possible contamination which may not have been removed by acid leaching of outer surface. δC^{13} = –1.54.

III. MISCELLANEOUS SAMPLES OF GEOLOGIC INTEREST

Florida

ML-77. Harney Pond I **>45,000**

Chione cancellata shells collected from newly dredged canal at Harney Pond near Lake Okeechobee, Florida (27° 00′ N Lat, 81° 05′ W Long). Fresh appearing Chione bed occurs 4 ft below surface, but believed to be of Early Pleistocene Fort Thompson age and therefore beyond C^{14} age. *Comment*: ca. 30% of sample leached away to remove surface contamination. Sample is dead.

Bahama Bank

Two sets of samples dated in this group: a stalactite from a submerged cave on Grand Bahama Island; and, a set of surface sands from the shallow banks surrounding the Tongue of the Ocean. Stalactite overgrown with marine carbonate of incrusting organisms is supposed to give time of cave submergence by rising sealevel. Shallow-bank surface sands give minimum age for sands swept down into the Tongue of the Ocean.

Grand Bahama Island Stalactite series

Stalactite sample (GB-1) 5″ x 3″ from submerged cave at S end Grand Bahama Island, B. W. I. (26° 30′ 12″ N Lat, 78° 40′ 48″ W Long, water depth 6 to 9 m). Coll. 1962 by J. Greenberg; subm. by G. A. Rusnak.

ML-78. Outer organic $CaCO_3$ overgrowth **22,570 ± 340**
20,620 B.C.

δC^{13} = +0.72.

ML-79. Stalactite center **34,970 ± 1400**
33,020 B.C.

δC^{13} = +0.32.

General Comment (G.A.R.): outer heavy crust of marine organic carbonate

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removed from stalactite by grinding after preliminary acid leach for removal of superficial incrustations. Dates determined on clean crust and stalactite separates demonstrate large difference, but contamination cannot be ruled out.

Bahamas Bank Surface Sand series

Grab samples of shallow carbonate sands from surface of bank margin surrounding the Tongue of the Ocean.

ML-83. Grab sample MG61-38 **1480 ± 60**
A.D. 470

Sample of skeletal beach sand collected from SW shore-line of Green Cay, Bahamas, B. W. I. (24° 02′ N Lat, 77° 11′ W Long). δC^{13} = +6.27.

ML-84. Grab sample MG61-34 **955 ± 50**
A.D. 995

Shelly sand collected by diving on shallow banks S of New Providence Island, B. W. I. (24° 43′ N Lat, 77° 23′ W Long, water depth 10 m). δC^{13} = +4.16.

ML-85. Grab sample MG61-41 **645 ± 50**
A.D. 1305

Shelly oolitic sand collected by diving on shallow bank SE of Cul de Sac in Tongue of the Ocean, Bahamas, B. W. I. (23° 25′ N Lat, 76° 31′ W Long, water depth 8 m). δC^{13} = +4.37.

ML-86. Grab sample MG61-45 **2025 ± 55**
75 B.C.

Shelly sand collected by diving at Queens Channel on S side of Tongue of the Ocean, Bahamas, B. W. I. (23° 24′ N Lat, 77° 03′ W Long, water depth 12 m). δC^{13} = +4.75.
General comment (G.A.R.): sample dates provide minimum ages for sand materials swept from bank surface into Tongue of the Ocean basin.

References

Date list:

Miami I Östlund, Bowman, and Rusnak, 1962
Yale VIII Stuiver, Deevey, and Rouse, 1963

Harrison, W., and Rusnak, G. A., 1962, Sea-level and crustal (?) movements at Chesapeake Bay entrance: 10,000-15,000 B.P.: Abstracts for the symposium on Coastal Geomorphology and Sedimentology, Am. Ass. Advancement of Sci., Geol. Soc. America, Program E (Geology and Geography), Joint meeting with Geol. Soc. America and Assoc. Am. Geographers, Philadelphia, Dec. 26-31, 1962, p. 15-16.

Olson, E. A., and Broecker, W. S., 1958, Sample contamination and reliability of radiocarbon dates: New York Acad. Sci. Trans., ser. 2, v. 20, p. 593-604.

Östlund, H. G., Bowman, A. L., and Rusnak, G. A., 1962, Miami natural radiocarbon measurements I: Radiocarbon, v. 4, p. 51-56.

Parker, G. G., Ferguson, G. E., Love, S. K., and others, 1955, Water resources of Southeastern Florida: U. S. Geological Survey Water Supply paper 1255, 965 p.

Rosholt, J. N., Emiliani, C., Geiss, J., Koczy, F. F., Wangersky, P. J., 1961, Absolute dating of deep-sea cores by the Pa^{231}/Th^{230} method: Jour. Geology, v. 69, no. 2, p. 162-185.

———— 1962, Pa^{231}/Th^{230} dating and O^{18}/O^{16} temperature analysis of Core A 254-BR-C: Jour. Geophysical Research, v. 67, no. 7, p. 2907-2911.

Stuiver, Minze, Deevey, Edward S., and Rouse, Irving, 1963, Yale natural radiocarbon measurements VIII: Radiocarbon, v. 5, p. 312-341.